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The Artist as Model User: Reflections on Creating with a Quantified Self

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ABSTRACT

The idea of the 'model user' is well established in Computer Science. However, the usual practice of establishing a model user might not be appropriate within the context of personal data where such models are potentially limiting and exclusory. The domain of self-tracking data art offers an alternative view on the concept of the Quantified Self. The model user then becomes that of the data artist. An 'edge case' where the user's representation of 'self' is determined more by creative skills and less by the tools used. Moreover, it is argued that models of creativity could be useful in order to understand the concept of Quantified Self as an on-going process. The Mace and Ward model is given particular attention and examples of artists work, including the author's own, are discussed in order to highlight the complexity of the issues they face and the ways in which they overcome them.

Author Keywords

Self-Tracking; Data Art; Quantified Self; Creativity; Model Users.

ACM Classification Keywords

• **Applied computing~Media arts**

INTRODUCTION

The idea of the 'model user' is well established in Computer Science [1, 2, 3]. It is the practice of understanding who is going to use your software and how they are going to use it. Software development then starts from the principle that developers need to make assumptions about the users they are designing for. The whole aim of having a model user then revolves around the idea of attempting to establish types of users that might want to perform specific tasks with new technologies.

This is largely true of the burgeoning phenomena of the Quantified Self, which has been steadily growing thanks to the development of affordable self-tracking technologies (STTs) that enable users to capture a multitude of data about their life-styles such as travel and location, eating habits, alcohol consumption, exercise and fitness levels, weight, and even the amount of sleep they get each night. Behind the explosion of these devices is the idea of a 'model user' as someone who wants to track their data for the purposes of self-improvement [4]. Largely motivated by a health and well-being agenda, there are many positive aspects to this idea [5]. However, it raises a number of questions about who's vision of the 'model user' this is and to what end do we want to quantify ourselves through data ultimately owned by third parties [6]. The concept of self is so much more than that which is quantifiable by any measure. Arguably, technologies that foreground this quantitative view of self, exclude alternative representations or, at least, promote a view of self that is unwittingly technologically determined and potentially myopic. In short, the usual practices of establishing a model user might not be appropriate within the context of personal data because the views established in such models are potentially limiting and exclusory.

Choe et al [7] have presented some clear insights into the wants and needs of the QS community as well as identifying some of the common pitfalls that non-professional data trackers encounter (e.g. tracking too many things and difficulties in combining data sets). There is also an additional body of work within the domain of 'life-long user modeling' that tracks similar issues such as: what to do about privacy and the sharing of personal data; how to deal with the lack of control over data aesthetics; and taking steps to combat the difficulties in combining disparate data sets within one interface [8, 9, 10, 11]. Alice Thudt's work on autobiographical visualizations and visual mementos has provided some very useful examples of system design that attempts to take the subjective experience of memory into account in relation to a range of objective/subjective data sources [12, 13, 14]. Similarly, the recent work of Huang et al, have focused on developing a taxonomy of design dimensions for tools to support data analysis in the non-professional setting [15]. All of this research is extremely insightful and useful in terms of thinking about personal

data and what we do with it. But there is one ‘use case’ that is particularly interesting because every example of it breaks the mold and brings to light what happens at the very edge of personal data use. That ‘model user’, if there is such a thing, is the data artist.

A MODEL OF CREATIVITY FOR QUANTIFIED SELF?

In order to begin to understand the relationship between the data artist and the realm of the quantified self it is worth first engaging with the literature on creativity. The reason being that arguably, the solution to expanding the quantified view of self lies in seeing the development of a quantified self as a creative act rather than just a tool for self-improvement. Todd Lubart [16] has surveyed fifty years worth of research into creativity. His insightful work describes the main thrust of creativity research, which has increasingly sought finer grained explanations of the complexities of creativity across a range of domains and tasks in an attempt to pin down key creative moments.

Early attempts at describing creativity originated in attempts to describe problem-solving as a number of stages [17]. These included perceiving a difficulty, defining the problem, suggesting solutions, elaborating the implications of these solutions and testing their validity. Later investigations into introspective accounts by creative individuals lead to the development of the classic four-stage model of creativity [18]:

- **Preparation:** Is the fully conscious stage where the problem is “investigated in all directions” through the gathering of intellectual resources that provide the basis for new ideas. Part research, part planning, part entering the right frame of mind.
- **Incubation:** Is an unconscious stage of processing where the problem at hand is temporarily left on the back burner and other activities are attended to. This gives the mind time to unconsciously connect ideas together without forcing a solution.
- **Illumination:** Is a flash of insight that arises out of the unconscious process of incubation. The moment where it all comes together into consciousness and a solution to the problem is intuited.
- **Verification:** Is the process of consciously working on the illumination to see if the idea really works in reality. It requires testing and validation against real world situations.

Despite the success of this model, it still best describes problem solving rather than creativity per se and certainly not artistic creativity (although it has been used in this context, many of the accounts were from physicists and mathematicians). However, there has been significant movement away from this model towards understanding the complexities of the relationships between everyday cognitive sub processes that constitute the larger creative

process as a whole. For example activities such as problem construction, information encoding, category selection and category combination as well as divergent and convergent thinking, have all been studied as components of the creative process [16].

As research has evolved, attempts to find ‘the moment of creation’ have given way to discussions about what makes a problem-solving process creative or not. So far the research points towards variations in the organisation, timing and time taken in various sub processes, which may be, structured in particular ways relevant to specific domains or the type of task at hand. In other words, creativity research points towards specificity in models for particular kinds of creativity in particular domains, rather than one generic model that describes all kinds of creativity.

This is interesting in relation to understanding how users engage with self-tracking tools in the pursuit of expressing a quantified self. Firstly, it reinforces the idea that the model user of self-tracking devices will inevitably be constrained by the types of tasks that designers envisage self-trackers performing, i.e. the domain of the quantified self that espouses the benefits of counting and quantifying a predetermined sets of data about ones self for specific purposes[4]. As opposed to a domain that questions what that data really says about ones self and how we might want it to be expressed. Secondly, it suggests that there is a range of models of creativity that could be adopted by the QS community in order to evolve the practice of self-tracking into a more creative process of self-representation. If, for example, we shifted the idea of a model user of QS away from self improvement and towards creative practice (as opposed to a scientific model of creativity), then a diversity of selves is likely supported, not just because artists are engaged in self expression but because artistic practice is an on-going, self-referential process of creation rather than a momentarily inspired act of problem solving. These ideas are interesting within the context of personalisation and life-long learning as well as QS [19, 20].

Mace and Ward [21] present an excellent description of a different four-stage model of artistic creativity that provides a very thorough and convincing argument for its contents. The main components of which are directly quoted here:

- **“Phase 1: Artwork Conception** is a process of identifying an implicit or explicit idea or feeling that could be a potential artwork. There are three major sources from which an idea for an artwork could be derived: the artist’s on-going art making enterprise, the interplay of life experience, and external influences.
- **Phase 2: Idea Development** is the complex process of structuring, extending and restructuring a particular artwork idea through a range of decision-making, problem solving, experimental, and information-gathering activities.

- **Phase 3: Making the Artwork** [is a process of wrestling with the] physical constraints that may or may not have been previously considered or foreseen. As the concept of the work informs the physical structure of the work, the process of physically making the artwork influences the development of the concept of the work. In this way content and form inform each other in an advancing process of development.
- **Phase 4: Finishing the Artwork and Resolution** [establishes whether the artwork is] considered viable to some extent [i.e. exhibition ready] or abandoned as nonviable and postponed, put into storage, or destroyed. The artists art-making knowledge is continually developed as a result of the dynamically interactive and on-going practice of art-making... new ideas for additional artwork arise, which serve to further explore areas of the artist's art making interest or to extend that interest into new realms. In this regard, rather than being a linear production process, making artwork is dynamically interactive, in so far as the making of an individual artwork is influenced by multiple factors, including the development of other artworks." [21]

In terms of a quantified self this model is useful for a number of reasons, most of which are not currently prioritised within the QS community.

1. Arguably, the process of developing a quantified self could be considered as a parallel to creative practice, as described by Mace and Ward, because, not only are they both creative acts involving reflection and representation, but also because they are self referential over long periods of time (months, even years). [Note: try rereading the Mace and Ward section but this time replace 'artwork' with the phrase 'representation of self']. Just as reflections on (and in) the process of making art informs decisions about making new art, as part of an on going project, so too reflections on (and in) self-tracking informs decisions about new goals or new types of self-tracking activity, to change, improve or develop oneself as a project.
2. The self referential nature of art making, i.e. making art about life experiences, external concerns or a personal aesthetic, mirrors very closely what the construction of a quantified self represents through the process of self tracking. Arguably, the production of artworks based on personal data can be considered as examples of self-expression, not just objective expressions of self.
3. The successes of art making processes are contingent on the artist's ability to visualise concepts and marshal their skill and knowledge towards their realisation. This in itself is determined by the agency that artists are afforded over their tools and materials of

production. The greater the agency, the greater the level of exploration and the richer and more successful the outcome will be. This is at the heart of the problem of thinking about QS as a creative act as the current model that drives the development of self tracking tools does not take into account creative repurposing. Thus, as we will see shortly, artists using such technology struggle at its edges to wrangle assemblage solutions for self expression.

SELF-TRACKING AND ART MAKING PRACTICE

There are numerous examples of artists and designers that are using data to provide visualizations of all sorts of things. Much of this is exemplified in the work of David MacCandless [22] whose work "Information is Beautiful" has done a lot to promote the notion of the information designer as someone that can bring order to confusion through the aesthetics of data visualization. Before him several other designers prepared the way, authors such as Edward Tufte who wrote several books providing examples of how information visualization can help identify and solve problems that had previously seemed intractable [23, 24, 25] and Jacques Bertin, the French Semiologist and map designer who was the first to systematically describe the parameters of data visualization formally [26, 27]. However, it is within the contemporary visual arts where the material of personal data is really being grappled with in interesting and novel ways. Here I will take the time to explore some of this work in order to identify some of the ways in which artists struggle to create work with data that is personal to them or others that have given it to them.

Lupi and Posavec

Perhaps one of the best, most original and recent examples of self-tracking data art is the work of Georgia Lupi and Stephanie Posavec [28]. These two women each tracked their data, on a weekly basis for twelve months, and then visualized it on postcards, (including a legend and instructions on how to read it) and sent it to each other via airmail. They both used a range of different tracking techniques supported by their smartphones and counting practices. The kind of data they investigated ranged from the number of people in a room at any given time to past histories, places they've lived, transportation used and compliments received from other people. The richness of their work comes from looking at the ways they have chosen to visualize their data. Everything is hand drawn giving the work an unprecedented level of intimacy to the work. The fact that they shared this practice between themselves increases this sense of intimacy as some very personal things are shared to contextualize the data. The work almost has the confessional sense of a diary but delivered through data. The most significant aspect of this work though, is that it is an excellent example of what can be achieved if you have total control of the data you track and the way in which you manifest it. Lupi and Posavec had absolute agency over what they produced from the type of data they chose to track, to the conception of the project

itself. Technology was only a means to an end, an aid to the tracking and representation activity. However, while the means to achieve the project appear Lo-Fi, there is actually quite a complex and sophisticated assemblage underpinning the work. For example, the requirements of such a project include, postcards, coloured pens, smartphones, different geographical locations and a postal service to enable the passing of data from to the other. Unpacking the use of the postal service reveals the network of relations that exist within that system, such as the people that collect and deliver the mail, the vehicles (vans, trains, planes) and the tracking system and machinery that sorts mail using postal codes. Not to mention the economics of mail delivery and the running and managing of the companies that perform these tasks. So what seems like a simple project is actually reliant on the smooth running of a completely separate socially constructed system that the artists had no control over what so ever. Heaven forbid a postal strike! So, in this case, agency, while evident on the level of tracking and visualization, is relinquished in exchange for a postage stamp that buys the services of another entity, which shapes their work. This is an interesting example of the way in which artists want to control the details of production but are happy to use external systems to deal with the issue of distribution.

Thinking about this work in relation to the Mace and Ward Framework it is easy to see Phases 1-4 in their work. Phase 1 is evident in the initial concept of the project but also in the invention of the weekly data-gathering task they set themselves. Phase 2 appears in the way in which they both individually tackled the data gathering task and their choice of visual representation on the postcard. Each card taken individually is a little experiment exploring how to visualize complex data relationships about the self. Phases 3 & 4 are really evident in the decision to turn the whole project into a book and publish it. It would be interesting to think about how QS tools might be developed to support the hugely diverse tracking activities of such artists, as they were tremendously underemployed in the making of this work.

Ellie Harrison

Ellie Harrison is an artist and self-confessed 'Recovering Dataholic' [29]. Her early work from 2001-2005, focused specifically on gathering and using data in her art practice. Before the advent of the smart phone, Harrison adopted life-logging practices such as documenting every meal she ate for a year (Eat 22), the number of times she sneezed in a year (Sneezes 2003) and the distance she travelled in a year using public transportation (Gold Card Adventures). She gathered her data using pocket notebooks and kept fastidious track of the time particular events occurred. This data was then transferred to spreadsheets in order to collate the material and help make sense of it. (Again, very little sue of digital self-tracking QS technologies here).

One of her projects culminated in 'Monthly Sculptures Determined by [her] daily Quantification Records', which were exhibited as part of her Postgraduate Degree Show in 2003. To make these works, Harrison kept records about fourteen different aspects of her daily life. These included, the number of steps she took, her body weight and body fat percentage, the number of people she spoke to everyday, website hits she received, text messages received, book pages read, gaseous emissions, spots, swear words and alcoholic beverages consumed each day.

"Each month this data was compiled to give a set of monthly averages, which was then applied to three specially devised systems to determine the form, colour and volume for a Monthly Sculpture. The form of the sculpture was dependent on the average number of alcoholic beverages consumed by the artist. The colour of the sculpture was dependent on the average number of swear words uttered by the artist and the volume of the sculpture was dependent on the average mass of the artist." [30].

In a similar vein her project 'Timelines' [31], can be seen as the culmination of her fascination with making art through data collection. For this project, Harrison kept track of how she spent every single moment of her time over a four-week period. To make this possible she established seventeen different categories of activity that described her life and she set about fastidiously recording the times that she switched from one activity to the next in her notebook. Collating all this data into spreadsheets again she transformed them into colour coded visualizations that were printed as wall sized charts. Harrison has admitted that this project nearly broke her as it was so demanding tracking every aspect of her life in such detail. Since then, she has given up data collecting and written a book about her experience of trying to kick the habit. 'Confessions of a Recovering Data Collector' [29], marks a turning point in her artistic development where she has moved away from her data collecting practice and focused on engaging politically with dominant power narratives through art as activism.

As a forerunner to our now self-tracking saturated culture, Harrison's early work provides significant insight into the kinds of things we see other people doing quite regularly today, e.g. tracking body weight, body mass and food consumption. Interestingly, because Harrison's data logging was an art practice, like Lupi and Posavec, she had a tremendous level of agency over how she went about it. Thinking about the Mace and Ward model, again it is fairly easy to see all 4 phases in Harrison's work. She decided what to track, and when (Phase 1) She worked with a range of data types and different materials in order to visualize the outcomes in a range of interesting ways (Phases 2+3). And she gave careful consideration to how she made this information available to the public in the form of exhibitions and publications (Phase 4). Harrison's obsession with data gathering though is a salutary tale, one

where she almost became completely consumed by the practices of tracking. While automated tracking in our devices may reduce some of that burden, the question of where work starts and stops still remains and there is increasing pressure not only to self-track but to make sense of that data in some useful way. Harrison's work provides some excellent examples of what can be done with data if we have control over it, but reminds us that even when we do have control over it, submitting to the practices of QS means we have to conform to their logic, even if we have constructed the rules ourselves.

Laurie Frick

Laurie Frick's work visualizes and physicalizes data from her everyday life too. She pretty much uses anything you can think of. For example her project Stress Inventory, takes data she has tracked about stressful moments from her day and visualizes it as a range of dots positioned across a canvas. The dots themselves are hand cut circles of leather and the different colours and sizes represent the time and intensity of the stressful experience. The work is visually very abstract but it gives form to the smaller, seemingly inconsequential, stressful moments that mount up overtime. Thus, the work provides some visual insight into something that usually goes unnoticed, the way in which stress can build up over time potentially becoming overbearing.

Her earlier project, Time Blocks [32] is a visualization of someone else's data, specifically Ben (Fenn) Lipkowitz, who has fastidiously tracked their daily use of time over several years now. Frick's visualization is built upon Lipkowitz [33] own categorization of their data particularly the overall structuring and colouring of the work. Lipkowitz was the tracker whereas Frick's contribution to the work has been to manifest the data in a physical format using beautifully crafted chunks of wood that have been hand coloured. Frick has taken these ideas further by tracking her own data, particularly sleep, and developed additional ways to visualize this using small wooden blocks and coloured leather, as well as smaller works involving paper cut out and construction.

Floating Data [34] builds on these ideas and is based on data captured by Frick on long walks around her neighbourhood. These works are manifest as large aluminium panels, that have had the data structure laser cut from them creating interesting positive and negative patterns of space that look like maps of city blocks and streets but which reflect deeper time related, counting and data collating practices. This idea has culminated in her FrickBits app, which is freely available on the Apple Store [35]. This App allows anybody to track his or her walk and turn it into visualization, encouraging everyone to become a Frick like data artist.

Frick is not naive about data sensitivities or issues of surveillance but she admittedly "relish[es] the notion that soon we will collect every possible bit of data about us" [32]. She is seemingly unphased by the negative aspects of

this surveillance culture. Ultimately, she thinks that we will end up owning our own data and this will be empowering. Much like the QS evangelists Wolf and Kelly [4], she focuses on the positives of self-tracking data and says little about the negatives. Perhaps this is because, unlike many general users, as an artist she has a handle on the data, a way to make sense of it through making art. A way to control what her data looks like and what it represents. This is not without its problems though. In direct communication with Laurie she gave some examples of the kinds of issues she has encountered over the past few years:

- "Some of the gadget-makers don't allow easy access to the data collected, or a reasonable way to download. For the Basis watch – before Intel bought the company, I was tracking skin temperature, heart rate, steps – which was measured once a minute over 24 hours. We had to actually hack the data upload to get access to the unusual dataset. The company really had no useful way to communicate the quantity of data they collected, and I dumped it into a (large) csv file, and used conditional formatting and color coding for rows of 24 hour days to see a super interesting data pattern. Skin temperature turns out to be the most accurate and useful data.
- If you want to measure something not directly tied to a gadget, it requires some hand measurement and recording system. For 18 months, I scored on a scale of 1-5 how my stomach felt and keywords of what I ate that day – daily. I ended up using "Mercury App" which had an email trigger to remind me, and a very rudimentary interface. I made artwork out of this and slowly correlated a digestive problem that went unsolved for years.
- After measuring sleep for 3 years, with almost a 1000 nights of EEG sleep data, the company Zeo went out of business and with very little notice shut down its service. This was a cloud based data service, all the sleep data was encrypted in the network, I was able to have all my data downloaded – but it became virtually impossible to continue to measure sleep in the 5 minute increments I had been using...even though the device worked, the hacks to grab sleep off the memory cards didn't capture the detail I had been gathering. Continuity is a problem.
- It's very hard to integrate multiple data sources, I wanted to combine – sleep score, sleep data, bedtime, steps, location, upset stomach (see above), sociability (estimate of how many minutes I talked that day), weight – and maybe a couple more things into a giant excel file that runs for about 4 years of daily data. It requires hand-work to clean and ensure the data is on the right date, and missing days are accommodated – its sounds easy, and it's not."

The material provided by Frick is most insightful, particularly in relation to the Mace and Ward model of creativity. For example she talks at length about the difficult process of making where technology often gets in the way of making, which Mace and Ward have characterized as a specific feature of Phase 3, where the act of making influences the idea as much as the idea shapes the form of the material the work is made from be it physical or digital. Likewise she also tracks data over long periods of time often with no plan for making work until ideas begin to emerge from the data. Phase 1 applies here in terms of idea generation but also Phase 4, as ideas are often put on the back burner, until technology issues are resolved, and then rekindled again.

Unlike, Harrison or Lupi and Posavec, Frick is more deeply engaged with self-tracking technologies and as a result has to work harder to establish the same kind of control over the data she captures. Moreover, the tools she uses have an effect on how she works. 'Hand cleaning' data from self-tracking systems is an incredibly time consuming process and reveals that much of the data they store are often not in a readily usable format. It is the having to work in the gap between different technologies that a great deal of frustration lies. This is where the 'hacker' mentality resides, the results of which can be incredibly creative and fruitful (the experimental Phase 2 of the Mace and Ward model). This hacker mentality does exist within the QS community but, as yet it is not widely perceived as a creative practice and the technology being used is more often a hindrance than a help in terms of developing a digital representation of self.

The Author's Own Work

The authors own research driven creative practice involves making art from data gathered during bicycle rides [36, 37, 38], data is gathered using several different mobile apps, that simultaneously track distance travelled, speed, GPS position, heart rate, altitude, x,y,z body position, G force, as well as automatically taking pictures with a GoPro camera [Mace and Ward's, Phase 1]. These different streams of data are not integrated in any way in their raw form, so the result is several different un-calibrated data streams that have to be wrangled into some form of relationship before visualization can begin. This is an experimental process [Phase 2] where a lot of time is spent coding using Processing [39] to give some kind of visual form to the data. The kinds of outputs generated have taken various different forms, for example [Phase 4]:

Photographs that were collated cropped and edited and then presented as a slideshow on a large format digital screen (Figure 1). The concept behind this work was that each individual image would stay on screen for sixty seconds, [the real time between successive shots taken by the GoPro camera whilst riding]. This approach is essentially forced on the artist as the technology does not have sufficient battery life to last for the full duration of a bike ride thus

only sampled data can be collected over the full duration of the ride. Thus the experience presented is that of the real place as seen by the camera but presented over the duration experienced by the author. This draws attention to the gap between what is seen on screen and what is not. Significant distances can be travelled in sixty seconds, which if omitted from the visual record gives a skewed view of what the place really looks like, a kind of high fidelity visual image but low fidelity time pixel.



Figure 1. Photographs and video of landscape taken while riding.

Large and small wall mounted artworks printed on canvases constructed from coloured squares arranged sequentially from left to right and top to bottom, representing the sequence of GPS points for discrete parts of the trails ridden. The colour of the squares is determined by the mixing of RGB colour channels in Processing that converted speed, altitude and heart rate into usable data and mapped it to the RGB colour palette (Figure 2).



Figure 2. Artwork made from speed, altitude and heart rate data.

Animated sonic installations that are projected in darkened rooms consisting of coloured dots rapidly moving across

the screen (Figure 3). The colour of the dots was determined using the same principles as the wall mounted canvases but the position of the dots was determined by the body motion data captured using Data Logger.

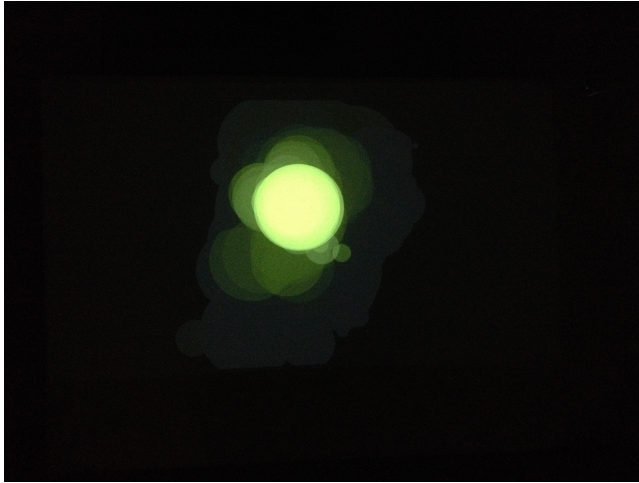


Figure 3. Screen shot from an animation made from gathered data.

The production of such works can be a long, complex and convoluted process, where the technology is both enabling and disabling in equal measure [Phase 3]. Often the possibilities of the technology inspire attempts to create something really interesting and original but then, like Frick has experienced, make it incredibly difficult to manifest as some really obscure piece of software has to be mastered in order to make it happen.

Self-Tracking and Data Mapping

This is true of much of the work emerging in many self-tracking technology driven projects. The artists that have made these projects have all been working in creative ways at the edges of their technological knowhow in order to not only achieve their desired outcome but to progress the domain forward in terms establishing ways to cross the boundaries between different technologies, data and visualization techniques.

Masaki Fujihata's *Impressing Velocity* [Mount Fuji], (1992-94) is a pioneering example. Using a head mounted video camera, a GPS receiver and a laptop in a rucksack he tracked his journey as he climbed mount Fuji. By recording changes in the speed of his climb he was able to use this data as a variable to affect a 3D model of the volcano upon return to his studio. The resulting outcome was a radically distorted 3D image of the volcano that reflected the drop in his speed as he neared the summit [40].

Similarly, Stephen Wilson used a GPS receiver coupled with a digital camera in a box that automatically uploaded images to a website, in order to create a device that automatically kept track of the networks of friendship that were created by gifting the device across a community. The box was presented to each member with strict instructions

to pass it on to someone else once they had finished with it. Thus maps and images of the 'life' of the box within the spaces of the community emerged [40].

Jen Southern's approach to self-tracking is similar but much more socially oriented. She tends not to track herself, but like Wilson, focuses on tracking other people as part of her projects. In *Running Stich* she and her collaborators built a real-time GPS mapping system that projected participants tracks across Brighton onto the gallery wall. Each of these tracks was then sewn into a hanging canvas (acting as the screen) to leave a record of each individual trace of activity within the larger 'tapestry' of movement across the city. In a similar vein, *Unruly Pitch* tracks the progress of the 'Uppies and Downies', mass football game that takes place once a year across the town of Workington, UK. The artists used GPS trackers on players, Drone footage, GoPro video, Digital photography and sound recordings to capture the action that took place during the match. The artworks that emerged from this process were threefold. A replica ball embossed with GPS tracks; Animated GPS tracks that reveal a video of the giant scrum and a digital map of the players tracked during the game [41]. This project in particular highlights the need for multiple modes of data capture and visualization to give a range of views on what is a complex unfolding of an event in a particular place.

Since 2004 Christian Nold has been making emotional maps of different places across the world using his Bio Mapping methodology as part of his art practice [42]. His San Francisco Emotion Map for example is the result of a five-week artist residency that involved 98 participants exploring the Mission District. Nold invited members of the public to go for a walk while wearing his Bio Mapping device, which records the wearers' emotional response to their environment through galvanic skin response and GPS data. The results of the walks were then mapped, using coloured dots (that represent the strength of the response) and personal annotations that relate to them.

Nold's work is not dissimilar to the work of Arlene Ducao and her team who produced the *Mindrider* project [43]. *Mindrider* (or *Multimer* as it is now known) is an EEG device that measures brainwave activity and maps it in relation to GPS data, to give a picture of arousal/stress level related to moving across the city. In its original guise it was a component in a bicycle helmet and the resulting maps highlighted the difference between stressful and peaceful cycling within the streets of Manhattan. Now the project has expanded and is being rolled out as a device that amalgamates multiple travel activities with other data sets about neighbourhoods. Brian House has also used cycling for one of his data projects. Capturing his breath rate, heart rate and cadence as he cycled to his studio one morning, while wearing an action camera to record the journey he worked with a composer to transpose the data into music to provide a soundtrack to the video he'd made. It is not a

direct data mapping but a piece of music closely informed by the data he captured.

TOOLS SHAPING US AND US SHAPING TOOLS

The German philosopher, Martin Heidegger, once wrote about tools and the experience of ‘smooth coping’ as a way in which we encounter the stuff of the world around us [44]. He gave the example of the hammer, which disappears from our consciousness as we become engaged in the act of ‘hammering’. The idea is that we no longer give thought to the hammer itself but are absorbed in the ‘smooth coping’ of using the tool (as well as the assemblage of nails and bits of wood we are joining). The tool only reappears to us if there is a problem with it, e.g we miss the nail (and hit our thumb), the head falls off, or the shaft breaks. If you couple this to the old adage ‘that if the only tool you have is a hammer then every problem looks like a nail’, then you very quickly find yourself in a world where smooth coping breaks down because hammers can’t solve every problem.

Self-Tracking technology is a little bit like the hammer. It disappears as we use it. We literally forget we are wearing such devices as they quietly gather data about us. More importantly, they hide the complexities of how they work beneath the simplicity of an interface and a set of rules for use that shape our behaviour. Essentially, the tool disappears as it semiotically shapes the construction of the mediated ‘quantified self’ it is creating. Importantly, just as the hammer is only good for hitting nails, self-tracking technology limits what is possible in terms of quantifying our selves. Tools have a shape, purpose and function, which of course exclude, like the hammer, other possibilities of operation. The upshot of this is that tools need to be modified, or a range of tools needs to be produced for a range of purposes, hence the tool kit. However, even a range of tools doesn’t mean that every problem has a solution that fits. More often than not even a combination of tools needs to be employed or a specific tool needs to be created to solve a particular problem. This is the key point to make. The power and agency of people as tool-makers not just tool users. The problem of course is that not everyone has the skill to make his or her own tools. But if the artists discussed in this paper can show us anything about using QS related tools, they can show us what happens when people wilfully engage with the breakdowns in ‘smooth coping’. All of the artists discussed here, including myself, have done this at some point, as part of their creative process, and it is this wilfulness to work with the bits that don’t fit together that leads to the originality in their artwork.

In a sense the notion of the Quantified Self brings us back to an old debate about technological determinism. On one hand it could be argued that the technology is determining and changing the behaviour of those that choose to use it (often in a positive healthy way) because the dominant model user in the domain is one that wants to submit to the rule of data for the sake of self-improvement. The systems

are often simple to use but, are extremely complex in their operations behind the scenes and the average user has little to no control over what they track or how they visualise it. On the other hand, what we see with the data artists is a willingness to engage with the technology at a different level. This leads to a different view of a model user in the domain. One where a creative practitioner is deeply involved in the practice of creating and maintaining a digital self through quantitative data and who also has a greater sense of ownership and agency in determining the use of the technology for representational purposes.

CONCLUSIONS

The tools of self-tracking are about constructing digital versions of ourselves that allow us to reflect to ourselves and others, who we are and how we change over time. Lack of agency and control over the tools we use to make these versions of ourselves, restricts our ability to manifest who we really want to be. For example, I may be ‘given’ control over my body in terms of tracking my fitness levels, or the capacity to map my position across the terrain of a mountainside but what if I want to express more of my experience? What if I want to capture and communicate how I feel at a specific moment on that journey? What kind of tool do I use to do that? If doing this is hard for artists like myself and Laurie Frick, then imagine the cognitive, temporal and financial overhead for people who, as yet, do not have this data-artist mind-set. Arguably, the complexities of the technology that afford us the ability to self-track in ways we could not have dreamed of several years ago, are in fact, by default, a barrier to the production of a true picture of self rather than an enabler. The simple act of capturing, storing and displaying heart rate data, for example, is now an everyday occurrence but it is only simple if we accept the conditions in which this data service is presented to us. This is fine if we are happy with letting other people control that service, much like the way Lupi and Posavec were happy to use the postal service in their work. However, the argument being presented here is that representations of self are fundamentally different when they are in the hands of systems and services that we do not control, as compared to representations of ourselves that we do control. Imagine a world where the only kinds of mirrors that you had access to were the kind you find in the fun house. What kind of a warped and distorted picture would you have of yourself if you could only see yourself in such mirrors?

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